936,447

PATENT SPECIFICATION

DRAWINGS ATTACHED

936,447

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COMPLETE SPECIFICATION

Making Pervious Adhesive Tape

We, JOHNSON & JOHNSON, a company organised and existing under the laws of the State of New Jersey, United States of America, of 501 George Street, New Brunswick, New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is drawn to pressure-sensitive adhesive films and more particularly to the preparation of pervious pressure-sensitive adhesive films without the use of solvents or punching and to the preparation of pervious adhesive tapes containing such films.

There has long been a demand for adhesive tapes which are pervious and permit the ready passage of moisture and air. Various methods for preparing such tapes have been proposed, including pattern spreading of pressure-sensitive adhesives onto pervious fabric backings to provide intermittent areas of fabric which are not coated with the pressure-sensitive adhesive, these non-coated intermittent areas permitting the passage of moisture and air. The methods generally employed for accomplishing this are to use some form of printing whereby the desired pressure-sensitive adhesive pattern is printed onto the surface of the fabric backing. There are, however, several objections to spreading the pressure-sensitive adhesive by printing, the primary objection being that it is generally necessary to use a solvent with the pressure-sensitive adhesive in order to transfer the adhesive, by printing, to the fabric backing. It is also difficult by this process to obtain a sufficiently heavy coating of pressure-sensitive adhesive to give the desired adherence when the pressure-sensitive tape is later used.

The use of solvents for spreading pressure-sensitive adhesive films, particularly in the manufacture of surgical adhesive tapes, is generally undesirable because of the difficulty in removing the solvent later, the remaining solvent often causing irritation to a user of the tape. Another objection to this process is the cost of using solvents which must generally be recovered in order to keep the cost of the process from being prohibitive. Because of this, pressure-sensitive adhesives, particularly when used in the manufacture of surgical tapes, are preferably spread on the fabric backing by a calender process. In the calender process, a thermo-plastic pressure-sensitive adhesive mass is first calendered into a thin film of pressure-sensitive adhesive and this film then calendered onto the fabric backing.

Pervious adhesive tapes on which the adhesive has been calender spread have heretofore been prepared by punching holes through the adhesive tape. This, however, is generally an unsatisfactory process. Not only is it uneconomical because of the waste caused by the removal of adhesive and backing, but the punching also substantially weakens the backing. This is particularly true where the backing is a fabric. When attempts were made to use hot needles or other projections for perforating the adhesive film without perforating the cloth backing, other difficulties were encountered. The heated projections, which perforate the adhesive by melting and causing the adhesive to flow out of the way of the projections, also cause an appreciable amount of the adhesive to flow through the fabric backing, particularly in the area immediately under the projections. This results in the back of the tape becoming tacky. This tackiness is objectionable since it interferes with the unwinding of the adhesive tape when later used. Also, the pressure of the heated projections on the fabric backing in many instances tends to cut or damage the fibers of the backing, thus weakening the same. It was further found that the heated projections sometimes tended to pyrolize the adhesive with resulting build-up of adhesive on the heated pins particularly at

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high operating speeds. The result is that frequent cleaning of these projections is necessary and uniform perforations are difficult to obtain over an extended period of operation.

It is the object of the present invention to prepare perforated pressure-sensitive adhesive films by perforating with hot projections or pins while avoiding pyrolysis of the adhesive on the hot projections. It is a further object of this invention to prepare perforate adhesive coatings without use of solvents or punching. It is a still further object of the present invention to prepare fabric-backed adhesive tapes in which the backing has not been weakened, in which the openings through the adhesive film remain open, and which are free from flow of adhesive through the backing to the uncoated side. Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example certain embodiments of this invention.

Referring to the drawings,

Fig. 1 is a schematic view showing the preparation of cloth-backed adhesive tape containing a perforate adhesive coating;

Fig. 2 is an enlarged view of a fragment of Fig. 1 showing the heated perforating projections;

Fig. 3 is an enlarged view of a fragment of Fig. 1 showing perforation of the adhesive film;

Fig. 4 is an enlarged cross-sectional view of the pressure-sensitive adhesive tape as it appears as it leaves roll 14 of Fig. 1;

Fig. 5 is a schematic view showing the preparation of adhesive tape having an elastic fabric backing and a perforated pressure-sensitive adhesive coating;

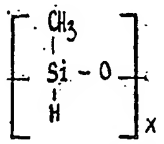
Fig. 6 is an enlarged view of a fragment of Fig. 5;

Fig. 7 is an enlarged view of a further fragment of Fig. 5; and

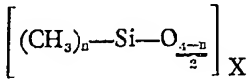
Fig. 8 is an enlarged view of another fragment of Fig. 5.

Pressure-sensitive adhesives of the type generally used in surgical tapes are extremely tacky at elevated temperatures and are generally of a relatively soft consistency. Also, the composition of the pressure-sensitive adhesive is generally of such nature that some deterioration may be expected to occur if subject to too high temperatures. Although it has heretofore been proposed to perforate pressure-sensitive adhesive film coatings by using heated projections, sometimes difficulty has been encountered in obtaining a sufficiently high temperature in the piercing pins or projections to cause rapid melting or flow of the pressure-sensitive adhesive in the immediate vicinity of the heated projections without using such high temperatures as to cause overheating of the pressure-sensitive adhesive with partial decomposition and build-up of pyrolized adhesive on the perforating pins. This problem could be avoided by coating the heated projections with a release agent. The use of a release agent, however, does not always completely avoid the problems heretofore mentioned in connection with the use of hot pins or other projections in the manufacture of perforated pressure-sensitive cloth-backed adhesive tapes, namely, flow of the adhesive through the cloth backing and weakening of the cloth backing during perforation. In accordance with the present invention, these difficulties have been avoided by first forming and perforating the pressure-sensitive film and then uniting the perforated film with the fabric backing, as hereinafter more fully described. Although it might normally be expected that the perforations would not remain open in the somewhat fluid pressure-sensitive adhesive film because of adhesive flow while the perforated film is pressed onto a fabric backing, in actual practice the openings are maintained substantially as formed and an excellent, pervious, strong adhesive tape is obtained.

It is generally preferred to carry out the perforation of the adhesive through the use of a steel or other metal roll having a plurality of projections which are heated during the perforating process. In preparing the roll for use, the whole surface of the roll is preferably coated with a release agent. The roll is then heated, generally for a period of at least 1/2 hour, to set the release agent on the surface of the roll and projections protruding therefrom. In heating the roll, temperatures in excess of about 150°F. are generally used. In practicing the invention, it was found that various release agents could be used, perforated pressure-sensitive adhesive films having been prepared through the use of various silicone polymers, stearo chromic chloride Werner complexes and isopropoxy titanium stearate. The best results, however, were obtained when the release agent was a silicone type resin, the preferred release agents being crosslinked methyl hydrogen substituted polysiloxane release agents of the general formula



either alone or preferably as mixtures in amounts of 2 to 98% by weight with polysiloxanes having the general formula



in which n may have values of 0, 1, 2 or 3.

The methyl silicone ratio for the mixtures falls between 1.3 and 2.0.

The preparation of cloth-backed pressure-sensitive adhesive tapes in accordance with the present invention is further illustrated by reference to the drawings. Referring to Fig. 1, a pressure-sensitive adhesive mass 10 is placed at the nip 11 occurring between the top roll 12 and the middle roll 13 of a conventional 3-roll calender. The calender rolls are generally maintained at a temperature of 180 to 320°F. for the top roll 12, a temperature of 140 to 240°F. for the middle roll 13, and a temperature of 80 to 180°F. for the bottom roll 14. The preferred temperatures are respectively 240 to 290°F. for the top roll, 150 to 180°F. for the middle roll, and 100 to 120°F. for the bottom roll.

The pressure-sensitive adhesive mass 10 is calendered into a film 15 which adheres to the surface of roll 13. Adjacent roll 13 is a perforating roll 16 containing projections 17, roll 16 being spaced with respect to roll 13 so that the ends of the projections 17 just contact the surface of roll 13. The projections, which preferably have a diameter of .004″ to .030″, may take any form depending on the type hole desired in the adhesive. In the preferred practice, the projections have flat ends, these giving the cleanest perforations.

The perforating roll 16 is heated by any conventional means, such as by heated fluid or electrically, to a temperature such that the projections 17 are maintained at a temperature of about 150 to 400°F., the preferred temperature being about 300 to 325°F. The projections 17 should be sufficiently long that the surface of the pressure-sensitive adhesive film 15 never contacts the surface of the roll 16 between the projection 17. This is best illustrated in Fig. 3. Since the pressure-sensitive adhesive film generally varies in thickness from about .001″ to .010″, it is preferred that the heated projections 17 be at least .020″ in length. As previously stated, the projections 17 are coated with a release agent which is cured onto the projections prior to their use for perforating the pressure-sensitive adhesive film 15. The coated projections 17 are best illustrated in Fig. 2, part of the projections being shown in cross section to better illustrate the coating 9 of release agent.

The pressure-sensitive adhesive film 15, after being formed, is maintained at a temperature only slightly below its flow temperature by heated roll 13 on which it is carried. As the film passes roll 16, the heated projections or pins 17 enter the warm film 15 causing a lateral flow of the pressure-sensitive adhesive away from the area occupied by the projections. Roll 16 is preferably rotated at the same peripheral speed as roll 13. However, where elongated openings in the pressure-sensitive adhesive are desired rather than round or square holes, this can readily be accomplished by having the roll 16 rotate at a slightly slower or faster peripheral speed than that of roll 13.

After passing between rolls 13 and 16, the perforated pressure-sensitive adhesive film, which is still maintained on the surface of roll 13, passes through the nip 18 between rolls 13 and 14. At this point, it is pressed into intimate contact with the surface of a fabric web 19 fed from a roll of fabric 20. The fabric 19 with the pressure-sensitive adhesive film 15 is then passed around a cooling drum 21 which serves to cool the pressure-sensitive adhesive film down to about room temperature. The fabric with the perforated pressure-sensitive adhesive coating is then formed into a roll which is later unrolled, slit and formed into smaller rolls of pressure-sensitive adhesive tape.

The perforate adhesive tape as it leaves roll 14 is best illustrated in Fig. 4 which is an enlarged view of section (c) of Fig. 1. The adhesive tape consists of the fabric backing 19 bonded to the perforated adhesive film 15. Since the film has been perforated prior to combining with the fabric, the fabric has neither been weakened by the perforating process nor has any adhesive been forced through the fabric to make the back of the tape tacky. Also, since the perforating is done between the smooth hard surface of roll 13 and projections 17, the holes 22 are cleanly formed, the surface of the fabric at the bottom of each hole being free of adhesive. As a result, a highly porous adhesive tape is obtained which, in the area of perforations, is as permeable as the fabric used. The process may be used to make pressure-sensitive adhesive tapes with any desired type of fabric backing, the permeability of the final product depending on the permeability of the fabric used as well as the number and size of the perforations in the adhesive film. The process is thus equally suitable with highly permeable readily wet fabrics as well as for making adhesive tapes from fabrics that have been treated with a water repellent so that the final tape, even though pervious to air, will not let water pass therethrough.

The practice of the present invention in making pervious fabric-backed pressure-sensitive adhesive tapes is further illustrated by the following example:

EXAMPLE

A compound of the following composition was preheated on a rubber mill to 260°F.:

Pale Crepe Rubber	33%
Disproportionated Resin	28%
Lanolin	10%
Cornstarch	5%
Zinc Oxide	8.5%
Aluminum Hydrate	9.0%
Zinc Dibutyl Dithiocarbamate	1.5%
Titanium Dioxide	5%

This compound was fed to a calender with top roll rotating at 1/5 the speed of the center and bottom rolls and the gap between the top roll and center roll set to deliver a film of adhesive mass 0.005" thick. Temperature of the top roll was 260°F., center roll 150°F. and bottom roll 100°F.

An engraved roll having 261 projections per square inch was used for perforating the film of adhesive mass. The projections on the roll were 0.020 x 0.022 inch at the base and 0.030 inch high with tapering cross section towards their ends. The surface of the roll, including the projections, contained a cured silicone film formed of a mixture of methyl hydrogen substituted polysiloxane and polysiloxanes of the type heretofore described.

The perforating roll, which was heated to 325°F. was pressed against the adhesive mass until it contacted the surface of the center roll of the calender. A pressure of approximately 200 lbs. per inch of roll width sufficed to penetrate the adhesive mass and leave a clean impression on the roll of the engraved pattern.

Cotton cloth of 80 x 80 construction having a weight of 2.8 oz/sq. yd. was pressed against the perforated adhesive mass by passing it between the bottom and center rolls of the calender under pressure by the bottom roll. The spread sheet was stripped off the center roll of the calender under tension, passed over a cooling drum and wound on a drum to yield a finished roll of adhesive plaster. The product was slit and wound into rolls of adhesive tape by conventional means.

Under optical examination, the product was found to have rectangular holes which presented a surface with 11.2% open area. Aging of the product rolls in air at 120°F. for 30 days and steam sterilization at 255°F. for 30 minutes did not materially affect the extent of open area. Tensile strength of the backing was unaffected. Testing moisture vapor permeability of the product by the method shown in U.S. Govt. Specification JANP—127 with double the recommended weight of absorbent indicated that the moisture vapor transmission rate of random samples varied from 350 to 450 grams per square meter per 24 hours.

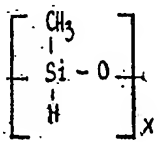
The perforated pressure-sensitive adhesive film prior to its application to the fabric 19 may, if desired, be removed from the surface of the roll 13 and cooled so as to give a continuous strip of pressure-sensitive adhesive having perforations therethrough. This pressure-sensitive adhesive strip may then be applied to any object to which it is desired to give a perforate pressure-sensitive adhesive surface. This is particularly useful in connection with the preparation of adhesive tapes having elastic fabric backings. Although elastic fabrics can be coated with perforate pressure-sensitive adhesive films in the manner described in connection with Fig. 1 of the drawings, difficulty is encountered by the fabric stretching at the point of release of the adhesive film from roll 13, since appreciable pull is exerted on the adhesive-coated fabric at this point. When preparing perforate adhesive-coated elastic fabrics, it is therefore preferred to use the process as described in connection with Fig. 5.

Referring to Fig. 5, a carrier paper 23 having a low adherence to pressure-sensitive adhesives is passed between the nip 24 of calender rolls 25 and 26. These rolls are heated to temperatures similar to the temperatures of rolls 12 and 13 of Fig. 1, roll 25 having a temperature similar to that of roll 12 of Fig. 1 and roll 26 having a temperature similar to that of roll 13. As the carrier paper passes between the nip 24, a pressure-sensitive adhesive mass 27 is calendered onto the carrier paper as a thin film 28. The carrier paper together with the pressure-sensitive adhesive film 28 then passes, while still on the surface of heated roll 26, by a heated perforating roll 29 which is similar to and acts in a manner similar to perforating roll 16 of Fig. 1. Roll 29, however, is spaced from roll 26 so that there is a slight clearance between the tips of the perforating projections 30 and the surface of roll 26, the clearance being equal to the thickness of the carrier paper 23. As perforation of the adhesive film is done solely by melting the pressure-sensitive adhesive in the vicinity of projections 30, no perforation of the carrier strip 23 occurs.

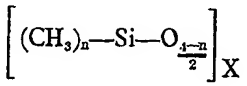
The carrier strip together with the adhesive film is then removed from roll 26 at which point it may be rolled up and stored for later use, such as application to an elastic fabric, or may be passed directly between rolls 31 and 32 together with a strip of elastic fabric 33 which is pressed against the perforated pressure-sensitive adhesive film. On leaving rolls 31 and 32, the carrier backing 23 is removed, leaving the elastic fabric with the perforated pressure-sensitive adhesive film secured thereto.

In practicing the present invention as des-

cribed in the preparation of adhesive tapes having elastic fabric backings, a carrier paper should be used that has a very low adherence to the adhesive film. For this purpose, it is generally preferred to use carrier papers having silicone resin release coatings, the preferred release coatings being mixtures of methyl hydrogen substituted polysiloxanes of the general formula



with polysiloxanes of the general formula



of the type heretofore described.

The invention is primarily concerned with the preparation of fabric-backed pressure-sensitive adhesive tapes. However, the use of a perforating roll in which the heated projections are coated with a release agent is also applicable to the preparation of perforated film-backed adhesive tapes.

Where the film material that is to form the backing of the tape is of a pervious nature, pervious pressure-sensitive adhesive tapes can readily be prepared in accordance with the process described in connection with Fig. 1, or if the film to be used as the backing is too yielding to permit removal without stretching from roll 13 (Fig. 1), the tape may be perforated in accordance with the process described in connection with Fig. 5. This is readily done by substituting the film backing in place of the cloth backing.

By practicing the present invention, uniform clean perforations through the adhesive mass can be obtained. The process is applicable with any of the generally used thermoplastic pressure-sensitive adhesives. Such compositions are well known in the art and described in patents and other literature, for example, U.S. patent 2,484,060, and U.S. patent 2,647,843. Where fabric-backed pressure-sensitive adhesive tapes are made in accordance with the present invention, not only is the tape found to be highly pervious, such for example as illustrated by the blowing of smoke therethrough, but the back of the tape is completely absent from any pressure-sensitive adhesive. Also, the fabric backing is in no way weakened by the perforating process.

In our co-pending Patent Application No. 31597/61 (Serial No. 936448) there is described and claimed a method of making a perforated pressure-sensitive adhesive tape or sheet comprising applying a layer of pressure-sensitive adhesive to a film backing, and passing heated projections through the film and the adhesive layer, the projections being coated with a release agent.

WHAT WE CLAIM IS:—

1. A method of making a porous pressure-sensitive adhesive film which comprises forming a film of pressure-sensitive adhesive, supporting the film on and in contact with a support from which the film can be readily removed, and passing heated projections through the film while so supported, to form perforations therethrough.

2. A method according to claim 1 wherein the supporting surface is heated.

3. A method according to claim 2 wherein the supporting surface is at a temperature between 140° and 240°F.

4. A method according to any of the preceding claims wherein the supporting surface is the surface of a roll.

5. A method according to claim 4 wherein the roll is one of a pair of calendar rolls which spread the adhesive into the form of a film.

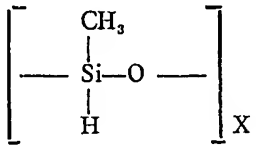
6. A method according to claim 5 wherein the other roll of said pair of rolls is heated to a temperature of between 180° and 320°F.

7. A method according to any of claims 4—6 wherein an inextensible carrier sheet or strip having poor adherence to the film such that the film can be removed therefrom substantially without distortion is interposed between the film and the supporting surface.

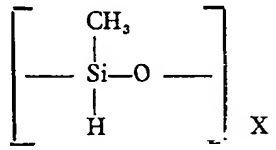
8. A method according to any of the preceding claims wherein the heated projections are mounted on the surface of a piercing roll.

9. A method according to any of the preceding claims wherein the projections are coated with a release agent.

10. A method according to claim 9 wherein the release agent is a cross-linked methyl hydrogen substituted polysiloxane of the general formula:



11. A method according to claim 10 wherein the release agent is a mixture of methyl hydrogen substituted polysiloxane of the general formula:



12. A method of making a pressure-sensitive adhesive tape or sheet which comprises applying to a pervious backing a film whenever produced by a method according to any of the preceding claims.

13. A method according to claim 12 wherein the film is subjected to a cooling treatment after being united to the backing.

14. A method according to claim 12 or 13 wherein the film is united to the backing by passing both film and backing through the nip between a pair of pressure rolls.

15. A method according to claim 14 wherein one of the pressure rolls is the roll that constitutes the supporting surface as set forth in claim 4.

16. A method according to claims 12—15 wherein the backing comprises an inextensible film or fabric web.

17. A method according to any of claims 12—16 insofar as they are appended to claim 7 wherein the backing is an extensible film or fabric web, the adhesive film being supported by the carrier until after the adhesive film has been united to the backing.

18. A method of making pervious pressure-sensitive adhesive tapes comprising placing a mass of thermo-plastic pressure-sensitive adhesive at the nip between the upper and middle heated rolls of a three roll calender, forming a film of the pressure-sensitive adhesive adherent to the middle roll, perforating said film of pressure-sensitive adhesive by pressing against said film of pressure-sensitive adhesive heated projections carried by a piercing roll, passing a pervious fabric between the nip formed by the middle and bottom roll of said three roll calender, and calendering said perforate pressure-sensitive adhesive film onto said fabric as it passes through the latter nip.

19. A method according to claim 18, wherein the middle and bottom rolls of said three roll calender are rotated at the same peripheral speed as the linear speed as said fabric, said top roll being maintained at a temperature of 180° and 320°F., said middle roll at a temperature of 140—240°F., and said bottom roll at a temperature of 80—180°F.

20. A method according to claim 18 or 19 in which the projections are heated to a temperature of 150°—400°F.

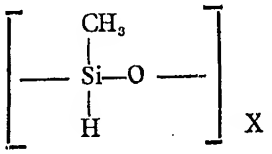
21. A method according to claim 18 in which the upper roll is maintained at a temperature of 240°—290°F., the middle roll at a temperature of 150°—180°F., and the bottom roll at a temperature of 100°—120°F., and the projections are maintained at a temperature of 300°—325°F.

22. A method according to any of claims 18—21 wherein the piercing roll is rotated at the same peripheral speed as that of the middle roll.

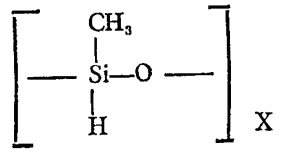
23. A method according to any of claims 16—22 wherein the projections are coated with a release agent.

24. A method according to claim 23 wherein the release agent is a silicone resin.

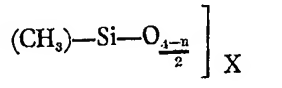
25. A method according to claim 24 wherein the release agent is a cross-linked methyl hydrogen substituted poly-siloxane of the general formula:



26. A method according to claim 25 wherein the release agent is a mixture of methyl hydrogen substituted polysiloxane of the general formula:



and polysiloxanes having the general formula:



in which n has values of 0, 1, 2 and 3, the methyl to siloxane ratio of said mixture being within the range of 1.3 to 2.0.

27. A method of making permeable pressure-sensitive adhesive tapes or sheets substantially as herein described and shown in the accompanying drawings.

28. A method of making permeable pressure-sensitive adhesive tapes as described in the foregoing Example.

29. A pressure-sensitive adhesive tape or sheet whenever made by a method according to any of claims 18—28.

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FIG. 3.

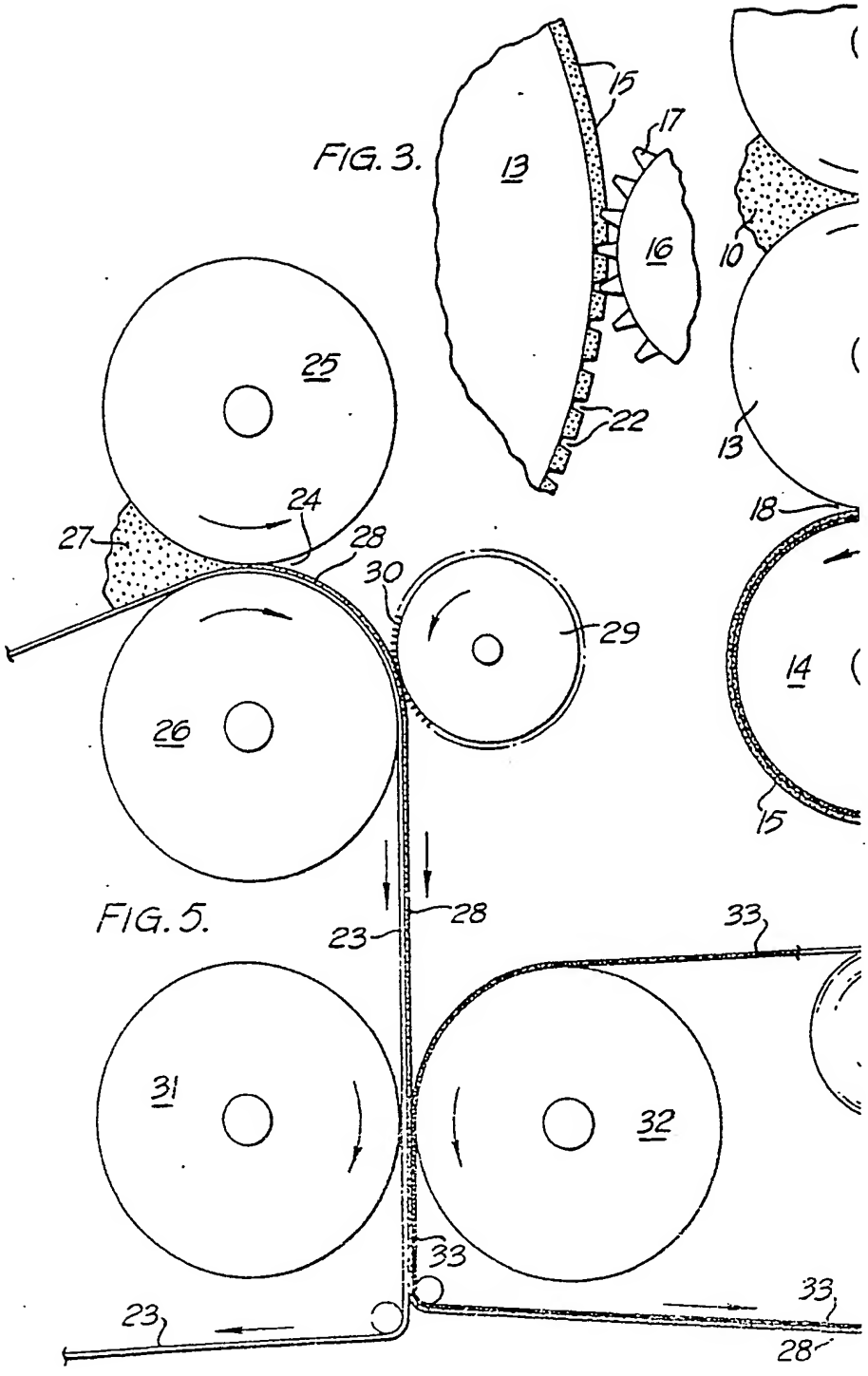
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FIG. 5.

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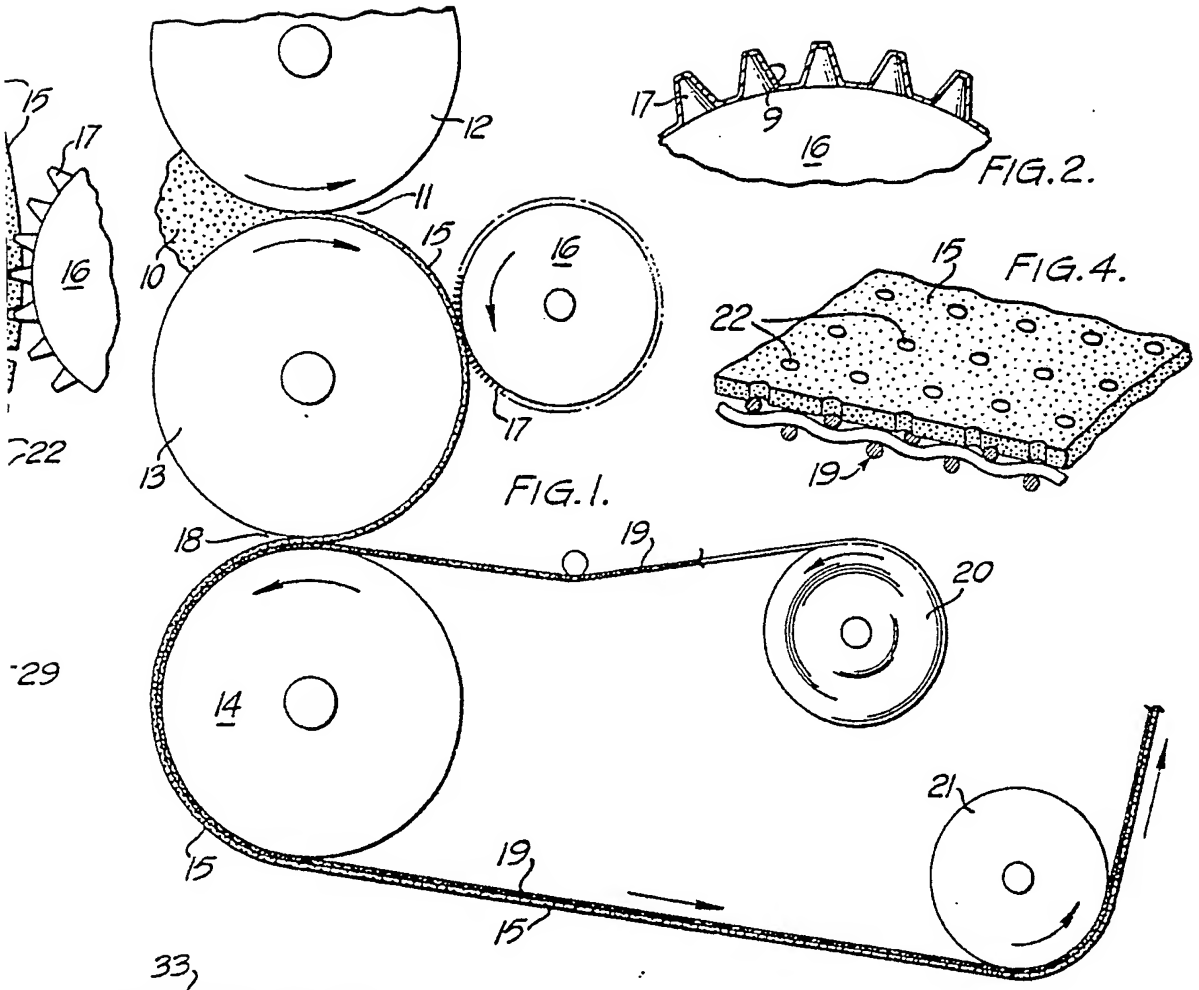

FIG. 1.

FIG. 2.

FIG. 4.

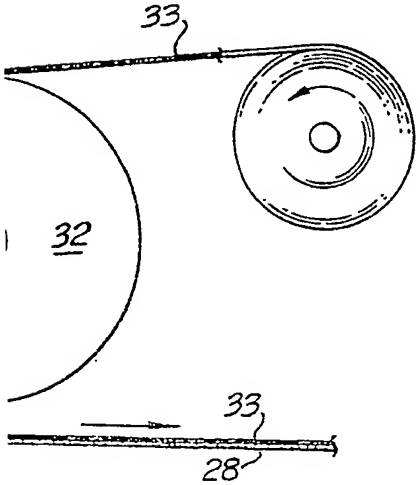

FIG. 6.

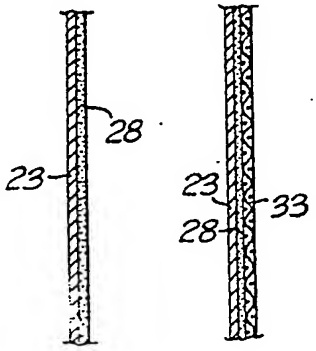

FIG. 7.

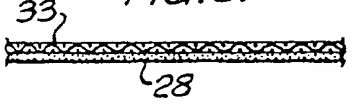

FIG. 8.

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